FORM PTO-1390 (Rev 5-93) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: **INTSER P27AUS**

U.S. APPLICATION NO. (If known, see 37 C.F.R.15): **10/069467**

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/SE00/01589	**August 18, 2000**	**August 26, 1999**

TITLE OF INVENTION

DIE-CASTING BRASS ALLOY WHICH IS RESISTANT TO DEZINCIFICATION

APPLICANT(S) FOR DO/EO/US

Carl-Åke DÄCKER and Ulla LANGELOTZ

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ■ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. ■ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ■ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ■ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ■ has been transmitted by the International Bureau. (PCT/IB/308 mailed **01 March 2001**).
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ■ A specification with paragraph numbers is attached.
7. ■ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ■ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ■ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ■ An Information Disclosure Statement under 37 CFR 1.97 and 1.98 with PTO FORM 1449.
12. ■ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ■ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification w/Marked-Up Version of Amended Specification.
15. ☐ A change of power of attorney and/or address letter.
16. ■ Other items or information:

■ Preliminary Examination Report	■ Copy of Request
■ Annexes to Pre. Ex. Rep.	■ Subm. of Proposed Dwg Amend. & Formal Drawings
■ International Search Report	■ 9 sheets of formal drawings
☐ German Novelty Search Report	■ Abstract
■ 4 copies of citations	☐ **Applicant Claims Small Entity Status**
■ Form PCT/IB/308	☐ Copy of Notification of File Missing Parts
■ International Publ. No. **WO 01/14606** (Face page only)	■ Original International Specification

CERTIFICATION UNDER 37 CFR 1.10

I hereby certify that this Transmittal Letter and the papers indicated as being transmitted therewith is being deposited with the United States Postal Service on this date **February 21, 2002** in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number **EP 918839996 US** addressed to the: Box PCT, Assistant Commissioner of Patents, Washington, D.C. 20231.

Scott A. Daniels
(typed or printed name of person mailing paper)

(signature of person mailing paper)

17. ■ The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(5): Search Report has been prepared by the EPO or JPO ..... $890.00 International preliminary examination fee paid to USPTO (37 CFR 1.492)(a)(1) .. $710.00 No international preliminary examination fee paid to USPTO (37 CFR 1.492)(a)(2) but international search fee paid to USPTO (37 CFR 1.445(a)(2)). ..... $740.00 Neither international preliminary examination fee (37 CFR 1.492)(a)(3) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... $1040.00 International preliminary examination fee paid to USPTO (37 CFR 1.492)(a)(4) and all claims satisfied provisions of PCT Article 33(1)-(4) $100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	1040	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	0	

Claims	Number Filed	Number Extra	Rate		
Total Claims	2 - 20 =	0	x $18.00	0	
Independent Claims	1 - 3 =	0	x $84.00	0	
Multiple dependent claim(s) (if applicable)			+ $280.00	0	
			TOTAL OF ABOVE CALCULATIONS =	0	
Reduction by 1/2 for filing by small entity, if applicable. **Applicant Claims Small Entity Status.** (Note 37 CFR 1.9, 1.27, 1.28).				0	
			SUBTOTAL =	1040	
Processing fee of $130.00 for furnishing the English translation later the ☐ 20 ☐30 months from the earliest claimed priority date (37 CFR 1.492(f)).			+	0	
			TOTAL NATIONAL FEE =	0	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property			+	40	
			TOTAL FEES ENCLOSED =	1080	
				Amount to be: refunded	$
				charged	$

a. ■ A check in the amount of $ **1,080.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. 04-0213 in the amount of $___ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ■ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 04-0213 . A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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02/21/02 PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	:	Carl-Åke DÄCKER and Ulla LANGELOTZ
Serial no.	:	
For	:	DIE-CASTING BRASS ALLOY WHICH IS RESISTANT TO DEZINCIFICATION
Docket	:	INTSER P27AUS

BOX PCT
The Commissioner of Patents and Trademarks
Washington, D.C. 20231

SUBMISSION OF PROPOSED DRAWING AMENDMENT FOR APPROVAL BY EXAMINER (37 CFR 1.123)

Dear Sir:

Attached hereto please find a copy of Figs. 1, 2 and 3 of the original drawings with red ink markings showing proposed changes to the drawing(s) of this application for which the approval of the Examiner is requested. Also enclosed are six (6) sheets of formal drawings which are to be entered in this case.

In the event that there are any fee deficiencies or additional fees are payable, please charge the same or credit any overpayment to our Deposit Account (Account No. 04-0213).

Respectfully submitted,

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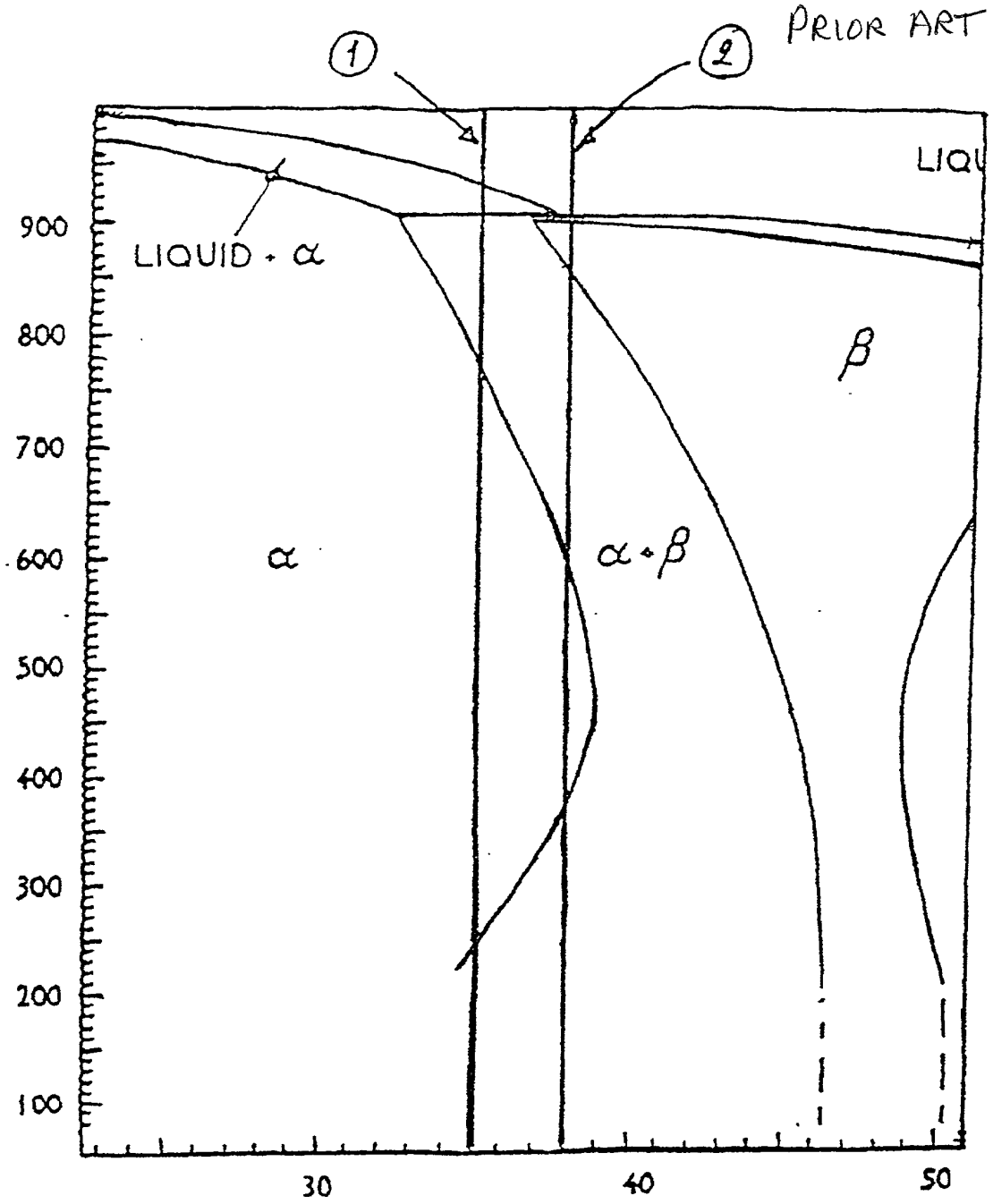
Fig. 1



Hot-learing tendencies and the binary copper-zinc phase diagram

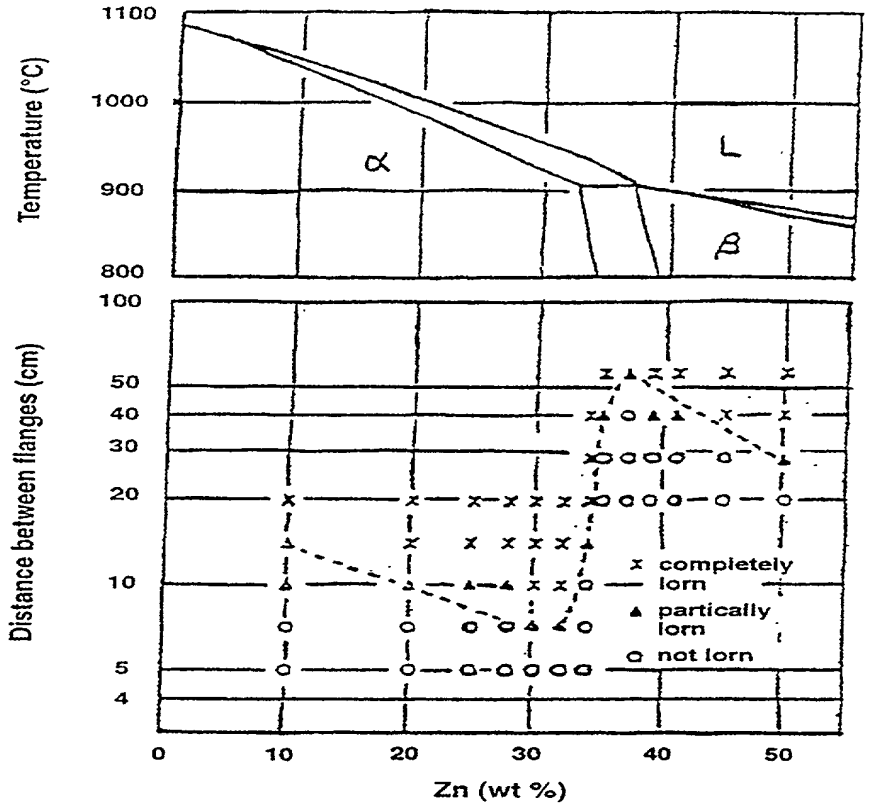


Fig. 2
PRIOR ART

The result of the dezincification tests.

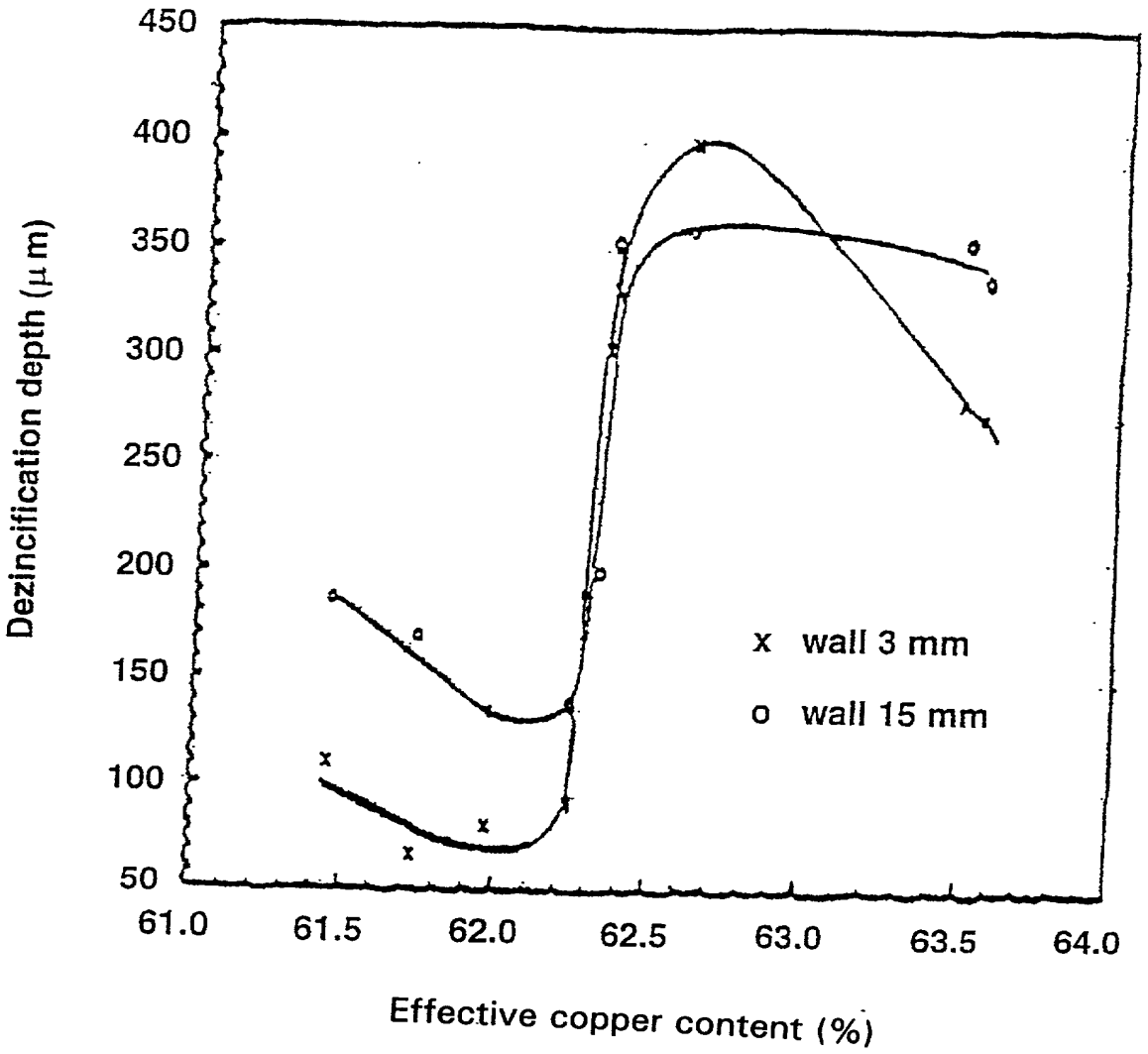


Fig. 3
PRIOR ART

02/21/02 PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	:	Carl-Åke DÄCKER and Ulla LANGELOTZ
Serial no.	:	
For	:	DIE-CASTING BRASS ALLOY WHICH IS RESISTANT TO DEZINCIFICATION
Docket	:	INTSER P27AUS

BOX PCT
The Commissioner of Patents and Trademarks
Washington, D.C. 20231

FIRST PRELIMINARY AMENDMENT

Dear Sir:

By way of preliminary amendment, please amend the above identified application as set forth below.

In the Specification:

Please cancel paragraphs 2, 3, 4, 15,and 19-27 of the specification, in their entirety, in favor of a clean form of paragraphs 2, 3, 4 and 15 of the specification, without any markings thereon, as follows. Accompanying this response is a copy of the original paragraphs of the specification which show the addition(s) (by underlining, highlighting and bold) and the deletion(s) (by strikeout) to the canceled specification paragraphs. Please enter the replacement specification paragraphs into the record of this case.

[002] FIELD OF THE INVENTION

[003] The present invention relates to a die-casting brass alloy, which is resistant to dezincification.

[004] BACKGROUND OF THE INVENTION

[015] SUMMARY OF THE INVENTION

[019] BRIEF DESCRIPTION OF THE DRAWINGS

[020] Fig. 1 shows a portion of a phase diagram Cu-Zn;

[021] Fig. 2 describes a problem with brittleness by heat;

[022] Fig. 3 shows a phenomenon with increasing dezincification depths with an increasing copper content;

[023] Fig. 4 shows how the amount of peritecticly solidifying materials (solidification primarily in the alpha-phase) quickly is reduced, when the copper content in the alloy is reduced, whereas the increase of the amount in the beta-phase in the final structure increases relatively slowly;

[024] Fig. 5 shows the result from investigations of the dezincification depth according to the international standard ISO 6509 for die-cast work pieces having a 6 mm thickness of material as to alloys having a varying Cu content; and

[025] Fig. 6 shows the result for the corresponding investigation with a material thickness of 16 mm.

[026] DETAILED DESCRIPTION OF THE INVENTION

[027] These conclusions have been confirmed by the results of an extensive development effort during several years, the purpose of which has ben to find appropriate alloy combinations.

REMARKS

Accompanying this response, please find marked-up paragraphs of the specification which overcome some informalities noted in the specification. The undersigned avers that the enclosed replacement paragraph(s) of the specification do not contain any new matter.

In the event that there are any fee deficiencies or additional fees are payable, please charge the same or credit any overpayment to our Deposit Account (Account No. 04-0213).

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

[001] DIE-CASTING BRASS ALLOY WHICH IS RESISTANT TO DEZINCIFICATION

[002] **FIELD OF THE INVENTION**

[003] The present invention relates to a die-casting brass alloy, which is resistant to dezincification ~~according to the preamble of claim 1~~.

[004] **BACKGROUND OF THE INVENTION**

[005] Dezincification is a problem for brass water fittings, when the water quality varies and maybe is strongly corrosive.

[006] It is known , that it is possible to treat the copper rich alpha-phase in brass against dezincification by means of small additions of arsenic or antimony, whereas the zinc rich beta-phase is not resistant to dezincification.

[007] Thus, it would be logical to keep a high percentage of copper in a brass alloy resistant to dezincification (as an alloy 1 in Fig. 1, showing a portion of the phase diagram Cu-Zn, Hansen, Constitution of binary alloys, New York 1958) in order to minimize or completely avoid the amount of the less corrosive resistant beta-phase. The problem with such an alloy is, that it results in a primary solidification of the alpha-phase in the form of long solidification crystals, so called dendrites, which means, that the beta-phase will form long bands between the alpha-dendrites. This results in two negative consequences :

a) The material will be brittle by heat ; and
b) The material will obtain a deep dezincification, since the dezincification will follow the long beta-phase bands.

[008] This phenomenon is thoroughly described in the following scientific article: Arno Louvo, Tapio Rantala, Veijo Tauta, "The Effect of Composition on as-cast Microstructure of alfa/beta-Brass and its Control by Microcomputer", LISBOA 84, 51 st International Foundry Congress.

[009] Fig. 2, which has been excerpted from this article, describes the problem with brittleness by heat, and Fig. 3, which has been excerpted from the same article, the phenomenon with increasing dezincification depths with an increasing copper content.

[015] **SUMMARY OF THE INVENTION**

[016] This object is attained according to the invention by the development of an alloy having the following characteristics.

[017] By balancing copper, zinc, silicon and aluminum in a capable manner it is possible to attain a solidification in the beta-phase and nevertheless avoid the development of continuous beta-phase areas in the finished product. The beta-phase will be found in isolated agglomerates in a matrix of alpha-phase, which is protected against a dezincification due to the arsenic addition. The primary solidification in the beta-phase with the alloy combination according to the invention combined with the high solidification speed of the die-casting limits the size of the agglomerates of the beta-phase in the final casting structure, the agglomerates also in a thick die-casting material with a low solidification speed obtaining an extension, which is clearly less than 100 μm. By means of fine grain-treatment with boron the size of the agglomerates and consequently also the depth of the dezincification can be additionally reduced.

~~[018]~~

~~[019]~~

[018] **BRIEF DESCRIPTION OF THE DRAWINGS**

[019] **The invention will now be described, by way of example, with reference to the accompanying drawings in which:**

[020] **Fig. 1 shows a portion of a phase diagram Cu-Zn;**

[021] **Fig. 2 describes a problem with brittleness by heat;**

[022] **Fig. 3 shows a phenomenon with increasing dezincification depths with an increasing copper content;**

[023] **Fig. 4 shows how the amount of peritecticly solidifying materials (solidification primarily in the alpha-phase) quickly is reduced, when the copper content in the alloy is reduced, whereas the increase of the amount in the beta-phase in the final structure increases relatively slowly;**

[024] **Fig. 5 shows the result from investigations of the dezincification depth according to the international standard ISO 6509 for die-cast work pieces having a 6 mm thickness of material as to alloys having a varying Cu content; and**

[025] **Fig. 6 shows the result for the corresponding investigation with a material thickness of 16 mm.**

[026] **DETAILED DESCRIPTION OF THE INVENTION**

[027] These conclusions have been confirmed by the results of an extensive development effort during several years, the purpose of which has been to find appropriate alloy combinations. ~~This is shown in the following drawings :~~

[028] Fig. 4 shows how the amount of peritecticly solidifying materials (solidification primarily in the alpha-phase) quickly is reduced, when the copper content in the alloy is reduced, whereas the increase of the amount in the beta-phase in the final structure increases relatively slowly.

[029] Fig. 5 shows the result from investigations of the dezincification depth according to the international standard ISO 6509 for die-cast work pieces having a 6 mm thickness of material as to alloys having a varying Cu content. The result is unambiguous. A dezincification minimum is attained exactly in the area, where the peritectic solidification ceases, at the same time as the amount of beta-phase has not yet become too large. The figure shows a dezincification depth for a maximal separate value as well as median values for a number of measurements, done on the same test object. The result is , that in a relatively wide area the obtained result falls below the requirements regarding the dezincification resistance according to BS 2872 of maximally 100 µm for a separate value.

[030] The object of the invention is to suggest an alloy , which also meets the dezincification requirements for thick die-cast materials, and Fig. 6 shows the result for the corresponding investigation with a material thickness of 16 mm. Also for this material thickness the requirement is met, namely maximally 100 µm for a separate value but within a more narrow interval.

[001] # DIE-CASTING BRASS ALLOY WHICH IS RESISTANT TO DEZINCIFICATION

[002]

[003] The present invention relates to a die-casting brass alloy, which is resistant to dezincification according to the preamble of claim 1.

[004]

[005] Dezincification is a problem for brass water fittings, when the water quality varies and maybe is strongly corrosive.

[006] It is known , that it is possible to treat the copper rich alpha-phase in brass against dezincification by means of small additions of arsenic or antimony, whereas the zinc rich beta-phase is not resistant to dezincification.

[007] Thus, it would be logical to keep a high percentage of copper in a brass alloy resistant to dezincification (as an alloy 1 in Fig. 1, showing a portion of the phase diagram Cu-Zn, Hansen, Constitution of binary alloys, New York 1958) in order to minimize or completely avoid the amount of the less corrosive resistant beta-phase. The problem with such an alloy is, that it results in a primary solidification of the alpha-phase in the form of long solidification crystals, so called dendrites, which means, that the beta-phase will form long bands between the alpha-dendrites. This results in two negative consequences :

a) The material will be brittle by heat ; and
b) The material will obtain a deep dezincification, since the dezincification will follow the long beta-phase bands.

[008] This phenomenon is thoroughly described in the following scientific article: Arno Louvo, Tapio Rantala, Veijo Tauta, "The Effect of Composition on as-cast Microstructure of alfa/beta-Brass and its Control by Microcomputer", LISBOA 84, 51 st International Foundry Congress.

[009] Fig. 2, which has been excerpted from this article, describes the problem with brittleness by heat, and Fig. 3, which has been excerpted from the same article, the phenomenon with increasing dezincification depths with an increasing copper content.

[010] In order to avoid the above-mentioned problems the alloy must solidify primarily in the beta-phase as an alloy 2 in Fig. 1, which allows the following advantages :

a) The amounts of micro and macro segregations will be substantially lower for an alloy, which solidifies primarily in the beta-phase. This is caused by the fact, that the diffusion speed in the beta-phase is about 1000 times higher than in the alpha-phase, which is a result of the fact, that its crystal structure has an atom arrangement according to bcc (body-centered-cubic) as compared to the atom arrangement of the alpha-phase fcc (face-centered-cubic).

b) The solidification crystals may be fine grain-treated with boron, which forms fine grains in a very efficient way, and only extremely small amounts of this substance is needed to obtain a fine grain-forming effect. According to experience boron does not have a fine grain-forming effect on brass, which solidifies primarily in the alpha-phase, whereas it is very efficient as far as nucleation of beta-crystals is concerned.

[011] The drawback is, that the beta-phase amount increases in the final casting structure and without a heat treatment it will be difficult to meet the toughest dezincification requirements according to BS 2872, which requires a maximal dezincification depth of 100 µm as a separate value. This is true above all for heavy thicknesses of material, shown in Fig. 3.

[012] The information above are known basic facts.

[013] Additional already known techniques are described in WO 89/08725 A1, EP 0 572 959 A1 and MNC manual no. 8, edition 2, September 1987, "Specialmässing", page 43.

[014] The object of the present invention is to suggest a way of eliminating the above-mentioned drawbacks.

[015]

[016] This object is attained according to the invention by the development of an alloy having the following characteristics.

[017] By balancing copper, zinc, silicon and aluminum in a capable manner it is possible to attain a solidification in the beta-phase and nevertheless avoid the development of continuous beta-phase areas in the finished product. The beta-phase will be found in isolated agglomerates in a matrix of alpha-phase, which is protected against a dezincification due to the arsenic addition. The primary solidification in the beta-phase with the alloy combination according to the invention combined with the high solidification speed of the die-casting limits the size of the agglomerates of the beta-phase in the final casting structure, the agglomerates also in a thick die-casting material with a low solidification speed obtaining an extension, which is clearly less than 100 µm. By means of fine grain-treatment with boron the size of the agglomerates and consequently also the depth of the dezincification can be additionally reduced.

[018]

[019]

[020]

[021]

[022]

[023]

[024]

[025]

[026]

[027] These conclusions have been confirmed by the results of an extensive development effort during several years, the purpose of which has been to find appropriate alloy combinations. This is shown in the following drawings :

[028] Fig. 4 shows, how the amount of peritecticly solidifying materials (solidification primarily in the alpha-phase) quickly is reduced, when the copper

content in the alloy is reduced, whereas the increase of the amount in the beta-phase in the final structure increases relatively slowly.

[029] Fig. 5 shows the result from investigations of the dezincification depth according to the international standard ISO 6509 for die-cast work pieces having a 6 mm thickness of material as to alloys having a varying Cu content. The result is unambiguous. A dezincification minimum is attained exactly in the area, where the peritectic solidification ceases, at the same time as the amount of beta-phase has not yet become too large. The figure shows a dezincification depth for a maximal separate value as well as median values for a number of measurements, done on the same test object. The result is , that in a relatively wide area the obtained result falls below the requirements regarding the dezincification resistance according to BS 2872 of maximally 100 µm for a separate value.

[030] The object of the invention is to suggest an alloy , which also meets the dezincification requirements for thick die-cast materials, and Fig. 6 shows the result for the corresponding investigation with a material thickness of 16 mm. Also for this material thickness the requirement is met, namely maximally 100 µm for a separate value but within a more narrow interval.

- At a Cu content of lower than 63.6 % the beta-phase agglomerates become so large, that they start to grow together, which results in a too large dezincification.
- At a Cu content of higher than 64.1 % the amount of primary solidification in the alpha-phase becomes so large, that long beta-phase bands develop between the alpha crystals and consequently a deep dezincification is obtained.

The positive results of this balancing of the alloy ingredients are summarized as follows :

1) Die-cast material, made of the alloy, meet, without a subsequent heat treatment, the requirements according to BS 2872 as to a maximal dezincification depth of 100 µm for a separate value
2) The alloy can be fine grain-treated with boron in an efficient way, which results in a most fine-grained structure in the finished product, which results in two advantages :

- The dezincification resistance is further improved, because the size of the beta-phase agglomerates is further reduced ; and
- The porosity in the die-cast material is distributed more evenly and the separate size becomes smaller, which reduces the risk of a leaky die-cast material and consequently the rejection costs for products, which must meet pressure impenetrability requirements, are also reduced.

3) The aluminum content can be kept at a low level, 0.03 – 0.1 weight-%, which means, that the positive effect of the aluminum addition on a die-casting alloy is utilized, but the negative effects are avoided.

- Positive effects include the strong dezincification effect of aluminum, which means, that also at a low aluminum content the oxygen content in the melt is stable and very low. Aluminum exerts also in small amounts a purification effect in such a way, that it reduces a zinc oxide coating on pouring cups, molding tools and cores ; and
- Negative effects include the formation in alloys , which include silicon and in which the aluminum content is larger than 0.1 weight-%, of a sticky slag, which consists of aluminum silicates. When a melt is applied with a cup, a portion of this slag will be introduced into the product, in which it forms "hazes" and "balls". These inclusions impair the mechanical properties of the finished product, but, what is worse, they function as capillaries, which means, that the dezincification follows the inclusions, if they reach the surface, which results in deep dezincifications, which by far goes beyond the requirements regarding the dezincification resistance according to BS 2872 of a maximally 100 µm dezincification for a separate value.

[031] In this respect the present invention differs from the fine grain-treated alloy according to DE-A 43 18 377 A1, which recommends an aluminum content of 0.3-0.7 weight-% and a silicon content of 0. -0.7 weight-%.

[032] A dezincification resistant alloy according to the present invention is characterized by the following compositions :

Cu:	63,0-65,5	weight-%
Pb:	1,5-2,2	weight-%
Si:	0,6-0,9	weight-%

Al:	0,03-0,1	weight-%
As:	0,03-0,1	weight-%
Ni:	max 0,5	weight-%
Sn:	max 0,5	weight-%
Fe:	0,1-0,5	weight-%
B:	0-15	ppm

Other impurities: max. 0.3 weight-%

Zn: remainder

[033] An example of a specified alloy, which has been produced for quite a long time on a large scale, has turned out to meet the requirements according to the invention quite well:

Cu:	63,6	weight-%
Pb:	1,8	weight-%
Si:	0,73	weight-%
Al:	0,07	weight-%
As:	0,06	weight-%
Ni:	0,2	weight-%
Sn:	0,3	weight-%
Fe:	0,25	weight-%
B:	8 ppm	

Other impurities : max. 0.3 weight-%

Zn: remainder

[034] The invention is not limited to the preferred embodiments specified above, but it can be modified and supplemented in an arbitrary fashion within the scope of the inventive idea and the following claims. This is particularly true, as regards the lead content, since lead is not dissolved in the alloy but remains as a separate phase, which does not influence the dezincification resistance. This means, that, if the lead content is reduced to below the specified interval, the rest of the alloy elements must be adjusted stochiometrically.

CLAIMS

1. A die-casting brass alloy having a dezincification resistance, which is lower than 100 µm for a separate value according to British Standard BS 2872 in a die-casting condition (i.e. without a subsequent phase transforming heat treatment), characterized by the following composition:

Cu:	63,0-65,0	weight-%
Pb:	1,5-2,2	weight-%
Si:	0,6-0,9	weight-%
Al:	0,03-0,1	weight-%
As:	0,03-0,1	weight-%
Ni:	max 0,5	weight-%
Sn:	max 0,5	weight-%
Fe:	0,1-0,5	weight-%
B:	0-15 ppm	

Other impurities: max 0,3 weight-%

Zn: remainder.

2. A die-casting brass alloy according to claim 1 having a dezincification resistance, which is lower than 100 µm for a separate value according to British Standard BS 2872 in a die-casting condition (i.e. without a subsequent phase transforming heat treatment), characterized by the following composition:

Cu:	63,6	weight-%
Pb:	1,8	weight-%
Si:	0,73	weight-%
Al:	0,07	weight-%
As:	0,06	weight-%
Ni:	0,2	weight-%
Sn:	0,3	weight-%
Fe:	0,25	weight-%
B:	8 ppm	

Other impurities: max. 0,3 weight-%

Zn: remainder

ABSTRACT OF THE DISCLOSURE

The present invention relates to a die-casting brass alloy having a dezincification resistance, which is lower than 100 µm for a separate value according to British Standard BS 2872 in a die-casting condition (i.e. without a subsequent phase transforming heat treatment). The alloy according to the invention is characterized by the following composition :

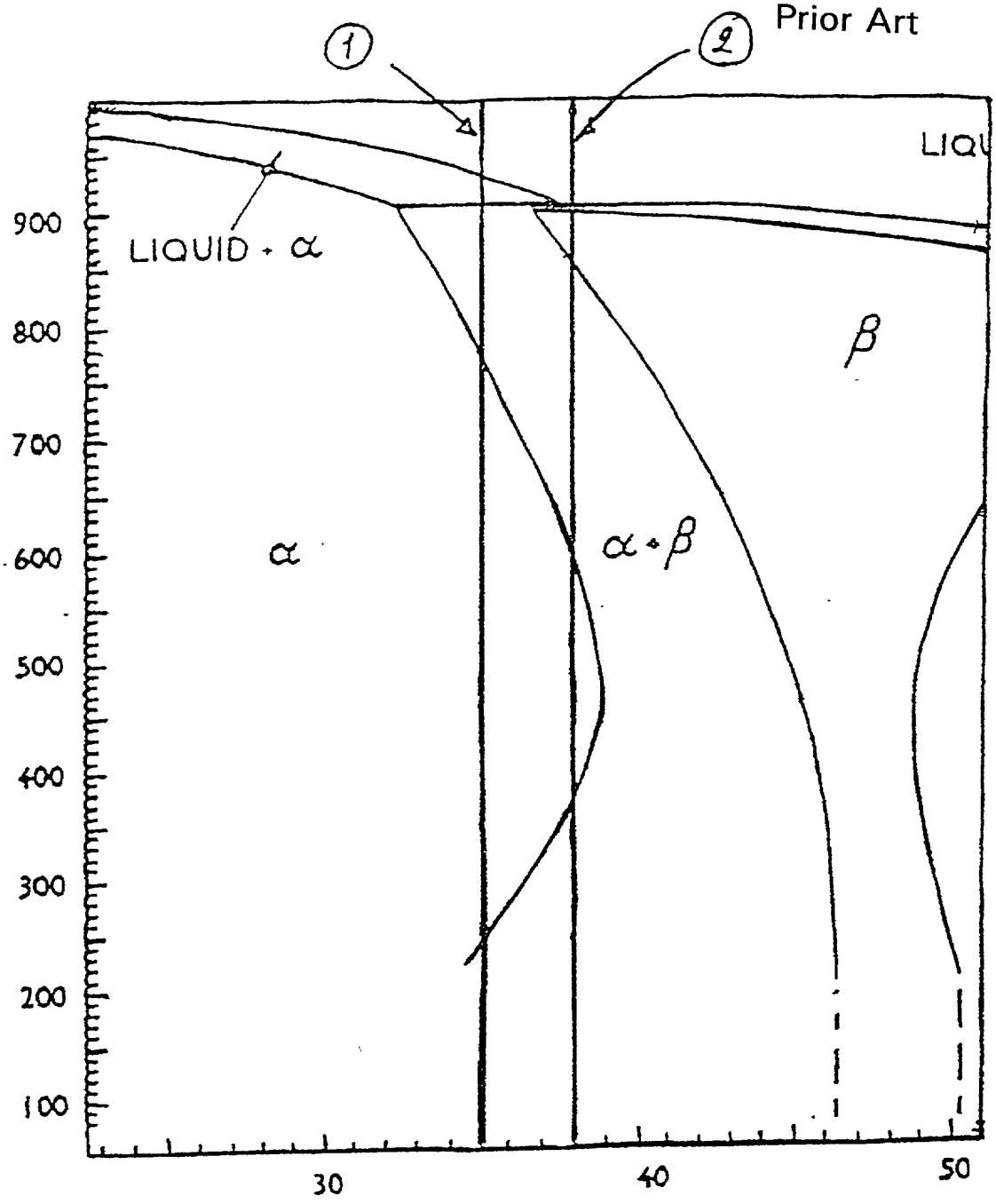
Cu:	63,6	weight-%
Pb:	1,8	weight-%
Si:	0,73	weight-%
Al:	0,07	weight-%
As:	0,06	weight-%
Ni:	0,2	weight-%
Sn:	0,3	weight-%
Fe:	0,25	weight-%
B:	8 ppm	

Other impurities: max. 0,3 weight-%

Zn: remainder.

Fig. 1

Prior Art



Hot-learing tendencies and the binary copper-zinc phase diagram

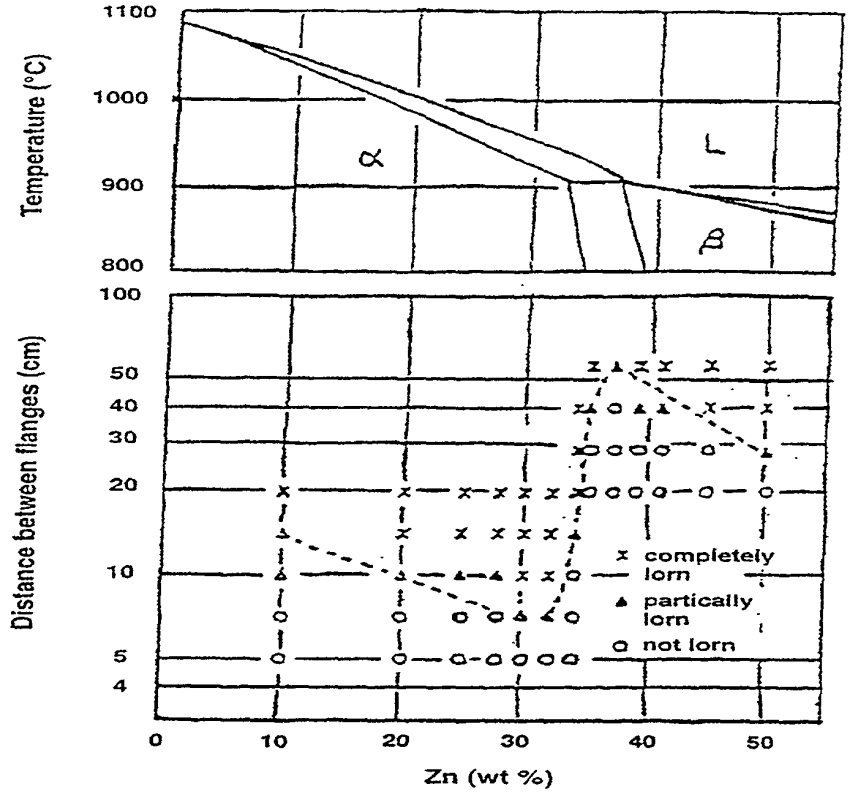


Fig. 2
Prior Art

The result of the dezincification tests.

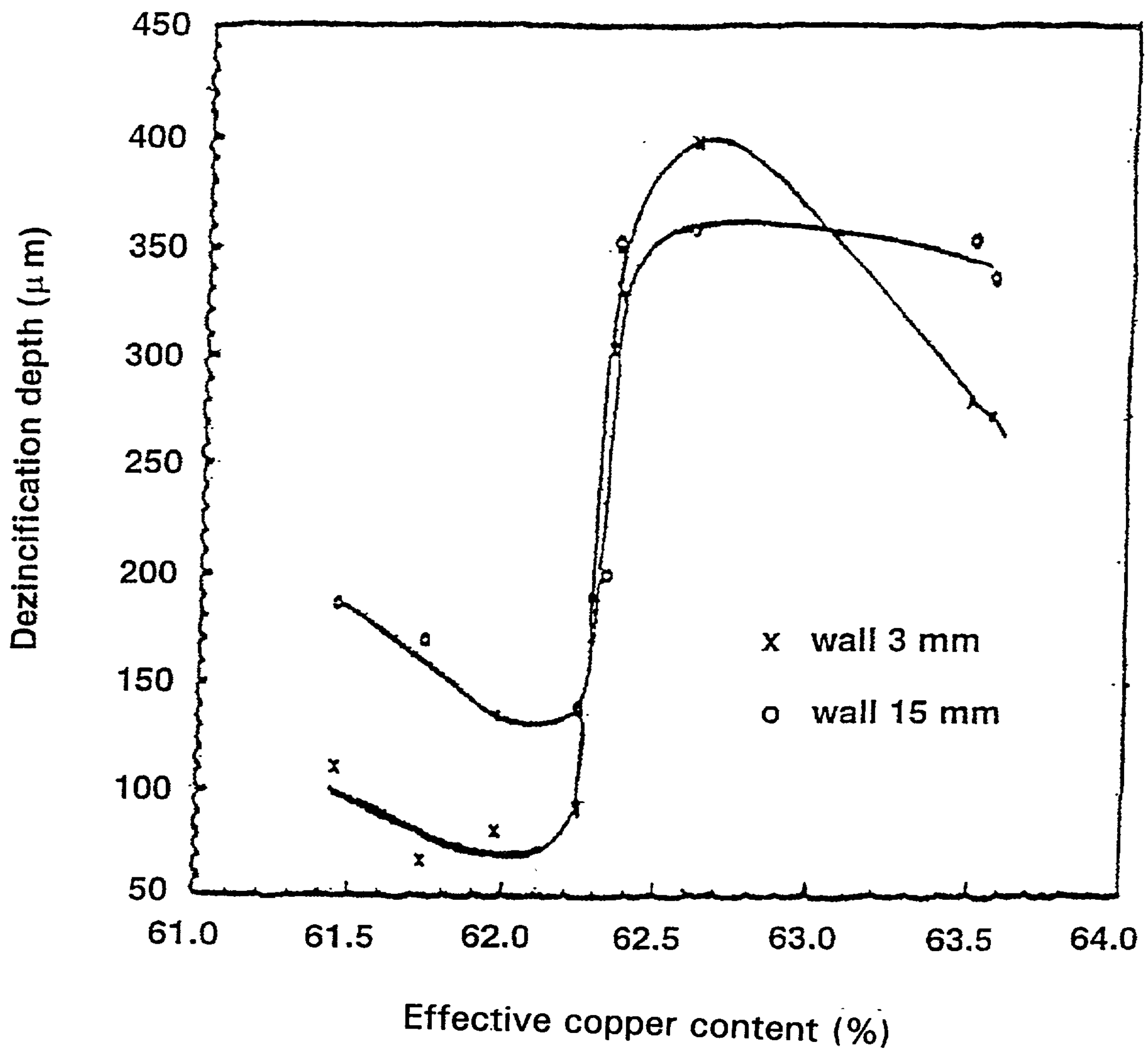


Fig. 3

Prior Art

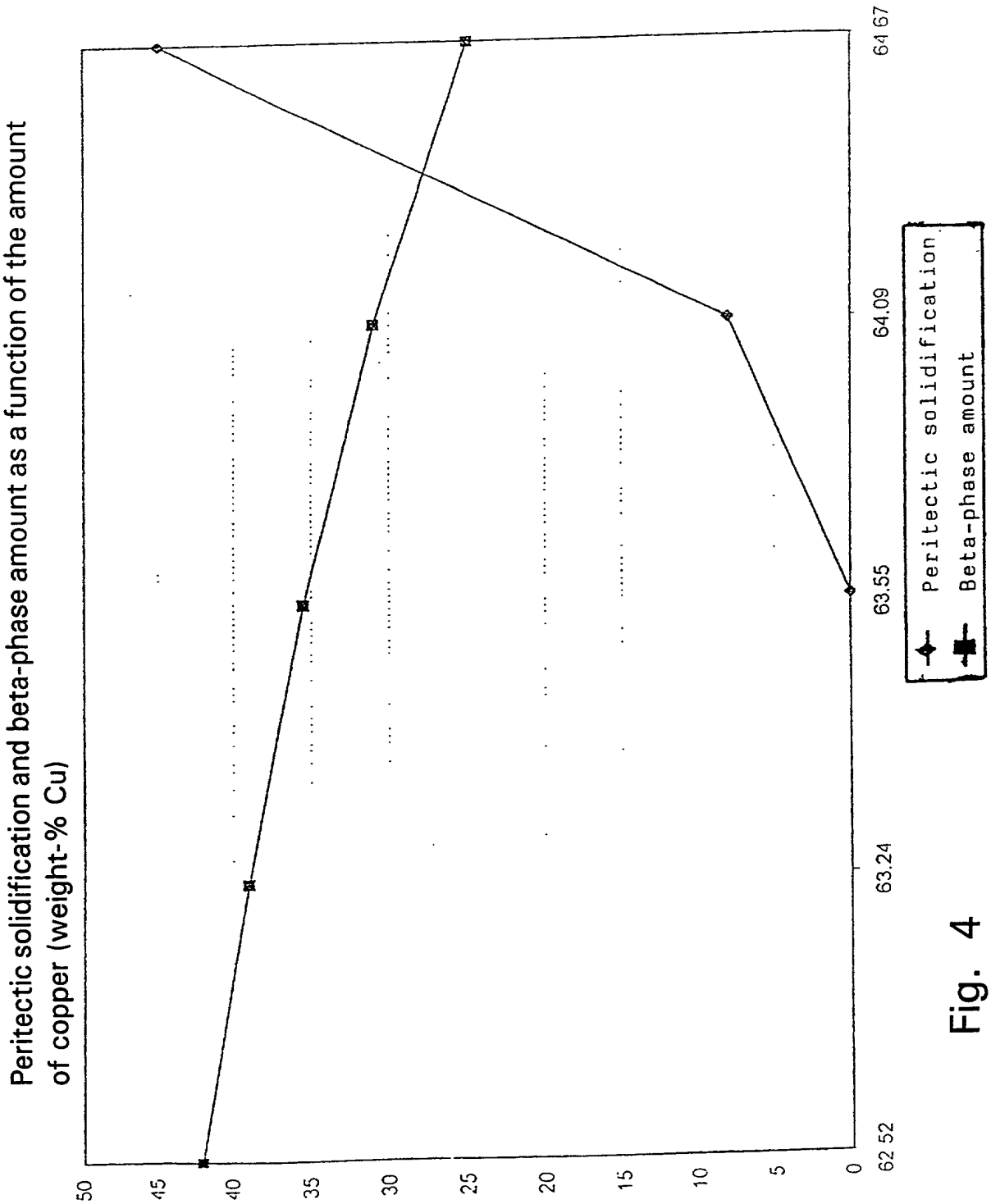

Peritectic solidification and beta-phase amount as a function of the amount of copper (weight-% Cu)
50
45
40
35
30
25
20
15
10
5
0
62.52
63.24
63.55
64.09
64.67
Peritectic solidification
Beta-phase amount

Fig. 4

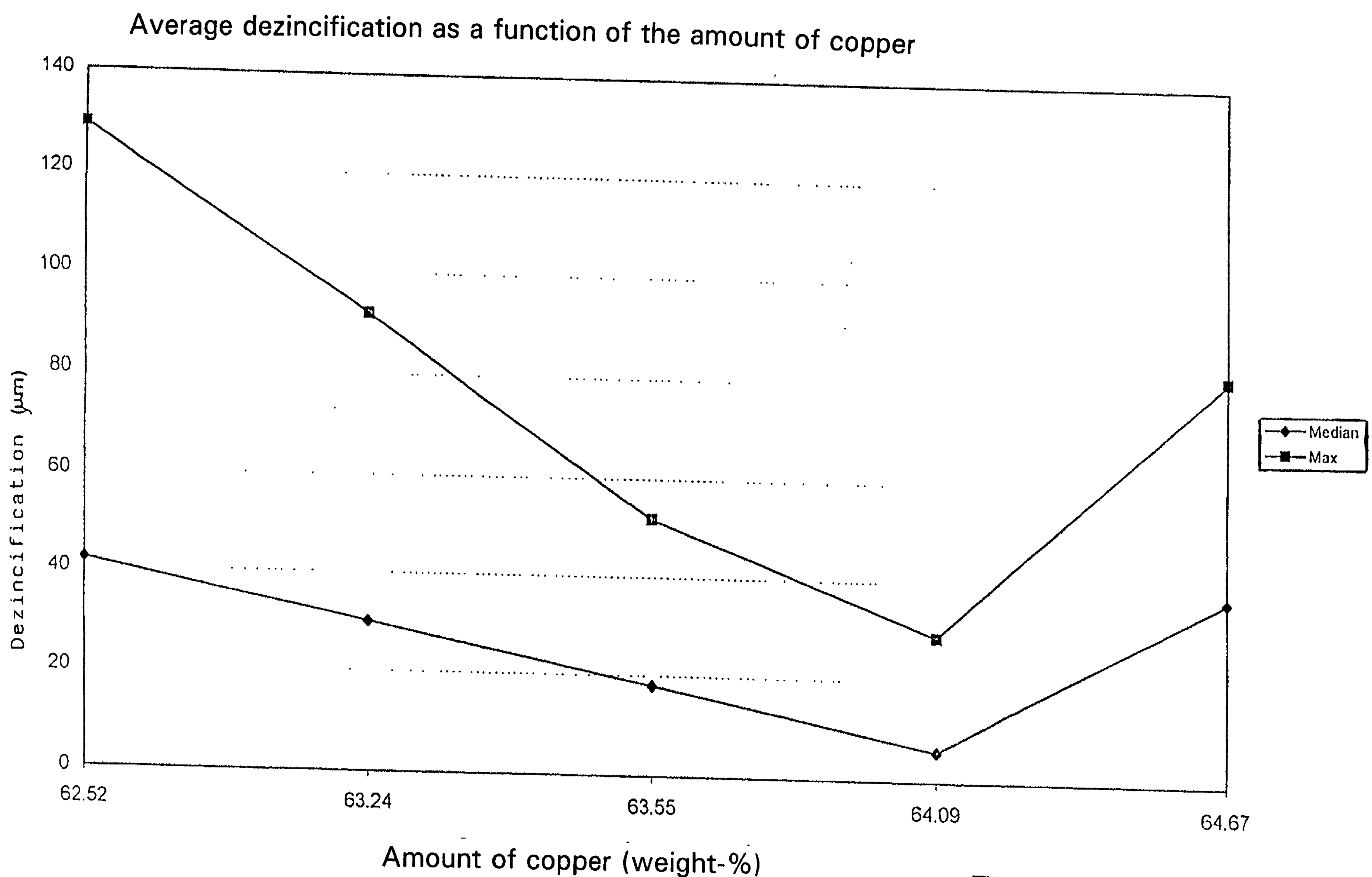

Average dezincification as a function of the amount of copper
140
120
100
80
60
40
20
0
Dezincification (µm)
62.52
63.24
63.55
64.09
64.67
Amount of copper (weight-%)
Median
Max

Fig. 5

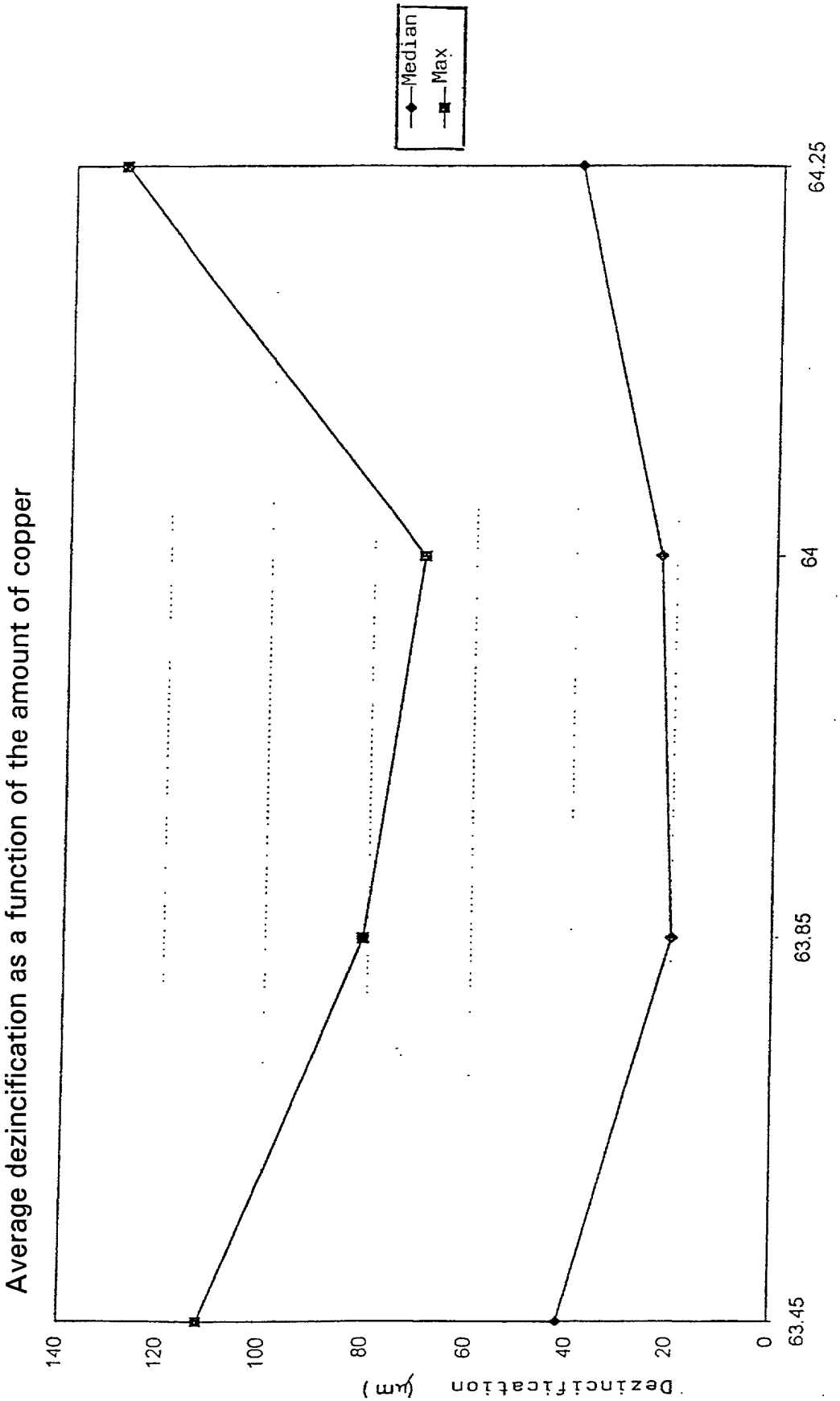


Fig. 6

COMBINED DECLARATION AND POWER OF ATTORNEY

(Original, Design, National Stage of PCT, Supplemental)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type: (check one applicable item below)

- ☐ original
- ☐ design
- ☐ supplemental
- ☒ National Stage of PCT
- ☐ divisional (see added page)
- ☐ continuation (see added page)
- ☐ continuation-in-part (see added page)

INVENTORSHIP IDENTIFICATION

My/our residence, post office address and citizenship is/are as stated below next to my/our name. I/We believe that the named inventor or inventors listed below is/are the original and first inventor or inventors of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

A die-casting brass alloy which is resistant to dezincification

SPECIFICATION IDENTIFICATION

The specification of which: (complete (a), (b) or (c))

(a) ☐ is attached hereto.

(b) ☐ was filed on _____ as
☐ Serial No. _____ or
☐ Express Mail No. _____ as Serial No. (not yet known) and was amended on _____(if applicable).

(c) ☒ was described and claimed in PCT International Application No. PCT/SE00/01589 filed on August 18, 2000 and as amended under PCT Article 19 on _____ (if any).

POWER OF ATTORNEY

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name(s) and registration number(s))

Anthony G. M. Davis	Registration No. 27,868
Michael J. Bujold	Registration No. 32,018
Scott A. Daniels	Registration No. 42,462

☐ Attached as part of this Declaration and Power of Attorney is the authorization of the above-named attorney(s) to accept and follow instructions from my representative(s).

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ACKNOWLEDGMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I/We hereby state that I/we have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I/We acknowledge the duty to disclose to the United States Patent Office all information which is known to be material to patentability of this application as defined in § 1.56 of Title 37 of the Code of Federal Regulations.

PRIORITY CLAIM

I/We hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me/us on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

EARLIEST FOREIGN APPLICATION(S), IF ANY FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

COUNTRY	APPLICATION NO.	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
Sweden	9903003-3	26/08/1999	☒YES ☐NO
			☐YES ☐NO
			☐YES ☐NO
			☐YES ☐NO
			☐YES ☐NO

ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

☐ I/We hereby claim the benefit, under 35 U.S.C. 119(e), of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YY)	☐ Additional provisional application numbers are listed on a supple-mental priority data sheet PTO/SB/02B attached hereto.

DECLARATION

I/We hereby declare that all statements made herein of my/our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Full name of third joint inventor:

Inventor's signature: Date:

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Full name of fourth joint inventor:

Inventor's signature: Date:

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Post Office Address: Same as above Country of Citizenship:

Full name of fifth joint inventor:

Inventor's signature: Date:

Residence:

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Full name of sixth joint inventor:

Inventor's signature: Date:

Residence:

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Full name of seventh joint inventor:

Inventor's signature: Date:

Residence:

Post Office Address: Same as above Country of Citizenship:

Full name of eighth joint inventor:

Inventor's signature: Date:

Residence:

Post Office Address: Same as above Country of Citizenship:

Full name of ninth joint inventor:

Inventor's signature: Date:

Residence:

Post Office Address: Same as above Country of Citizenship:

Full name of tenth joint inventor:

Inventor's signature: Date:

Residence:

Post Office Address: Same as above Country of Citizenship: